Application

for

United States Patent

To all whom it may concern:

Be it known that, ***Yong LIANG****, has invented certain new and useful improvements in a*

SYSTEM FOR TESTING SUBSCRIBER LINES AND METHOD THEREOF

of which the following is a description:

System for Testing Subscriber Lines and Method thereof

Field of the Technology

[0001] The present invention relates to testing technique in network communication, more particularly to a system for testing subscriber lines in network communication and method thereof.

Background of the Invention

[0002] With the development of broadband access technology, Data Subscriber Loop (DSL) technology that is used for subscriber loop access is gradually becoming a main and widely applied broadband access technology. Subscriber lines are laid for common narrowband telephone service. However, frequency band and speed of DSL is 10 to 1000 times greater than that of common narrowband telephone service. Furthermore, development of DSL service is affected due to some problems concerning with subscriber lines, such as long-term laying, poor maintenance, large environment interference and long distance. In order to satisfy requirements for opening line pre-selection and breakdown maintenance of DSL service, subscriber line testing technique has gradually being developed.

[0003] At the present time, subscriber line testing technique has been highly valued by both device manufactures and telecom service providers, henceforth applied in a large scale.

[0004] Generally, a broadband line testing module for implementing subscriber line testing is placed in a Digital Subscriber Line Access Multiplexer (DSLAM) end. The broadband line testing module is connected to the subscriber lines to be tested, evaluating line quality and judging line breakdown by using different broadband testing techniques, thereby implementing single-terminal broadband testing for subscriber lines, as is shown in Figure 1.

[0005] The object of subscriber line testing is to test those subscriber lines loading DSL. However, for the existence of Remote Terminal Unit (RTU) in user end, when breakdown is tested, there is no way to confirm whether the breakdown is from

the subscriber line or RTU, thereby affecting precision of the present subscriber line testing technique, even disabling some certain subscriber line testing techniques. Consequently, when testing with the present subscriber line testing technique, the subscriber is often telephoned and required to manually disconnect RTU from the subscriber line; after completion of testing subscriber line procedure, the subscriber is telephoned again to connect RTU up. The RTU includes RTU of Asymmetrical Digital Subscriber Loop (ADSL), Very-high-speed Digital Subscriber Loop (VDSL), or Single-line-pair High-bit-rate Digital Subscriber Loop (SHDSL).

[0006] As to the present subscriber line testing technique, during the testing procedure, there must be a person at the user side to cooperate, otherwise subscriber line testing procedure cannot be normally performed or the result of testing subscriber line is of low precision. Therefore, it is unlikely for DSLAM to implement routine line evaluation or record line health file. Accordingly, line maintenance and breakdown positioning may not be well implemented using subscriber line testing technique, going against popularization of subscriber broadband access technology.

Summary of the Invention

[0007] The present invention provides a system and a method for testing subscriber lines, with which subscriber line testing precision is guaranteed and subscriber lines can be periodically tested without manual operation.

[0008] The technical scheme of the present invention is implemented as follows.

[0009] A system for testing subscriber lines comprises a broadband line testing control module and a remote terminal subscriber access control module located at a subscriber line between the broadband line testing control module and a remote terminal unit, wherein

[0010] said broadband line testing control module sends a signal of disconnecting the subscriber line to the remote terminal subscriber access control module, and tests the subscriber line;

[0011] said remote terminal subscriber access control module receives said signal from the broadband line testing control module, and controls the remote terminal unit to disconnect from or connect to the subscriber line based on said signal.

[0012] Said broadband line testing control module comprises:

[0013] a broadband line testing module, for sending a signal of disconnecting subscriber line, implementing performance testing for subscriber lines and obtaining testing results after the remote terminal unit is disconnected from the subscriber line; and

[0014] a remote terminal subscriber control module, for receiving the signal of disconnecting subscriber line from the broadband line testing module and forwarding it to the remote terminal subscriber access control module.

[0015] Said remote terminal subscriber access control module comprises:

[0016] a switch control module, for receiving the signal from the broadband line testing control module, and generating a control signal and transmitting said control signal; and

[0017] a remote terminal subscriber control switch, for receiving said control signal from the switch control module and disconnecting the remote terminal unit from the subscriber line based on said control signal.

[0018] Said switch control module comprises a timer circuit, and said timer circuit is triggered based on the signal sent by the broadband line testing control module, and determines time-out time based on the testing required time value which is carried in this signal; when overrunning the defined time-out time, the timer circuit notifies the switch control module to send the remote terminal subscriber control switch a control signal of setting it at off status;

[0019] said remote terminal subscriber control switch controls the remote terminal unit to connect to the subscriber line after receiving said control signal of setting the remote terminal subscriber control switch at off status from the switch control module.

[0020] Said remote terminal subscriber access control module is a relay.

[0021] Said broadband line testing control module is located in a Digital Subscriber Line Access Multiplexer (DSLAM);

[0022] said remote terminal subscriber access control module is located at the subscriber line between a splitter in user end and the remote terminal unit, or located at the subscriber line between the splitter in user end and the DSLAM.

[0023] A method for testing subscriber lines based on the above-mentioned comprises the following steps of:

[0024] A. a broadband line testing control module sends a signal of disconnecting subscriber line to a remote terminal subscriber access control module;

[0025] B. the remote terminal subscriber access control module disconnects a remote terminal unit from the subscriber line after receiving said signal of disconnecting subscriber line; and

[0026] C. the broadband line testing control module tests the subscriber line.

[0027] Said signal is transmitted through a message based on G994.1 protocol.

[0028] The method further comprises before step A:

[0029] the broadband line testing control module sends a handshake message to the remote terminal unit, and determines whether said remote terminal unit supports the testing based on the returned message from the remote terminal unit, if yes, executes step A; otherwise, ends this processing.

[0030] Said signal in step A carries a testing required time value;

[0031] the method further comprises in step B:

[0032] after receiving the signal, the remote terminal subscriber access control module triggers a timer, and determines a time-out time based on the testing required time value which is carried in said signal;

[0033] when overrunning the time-out time, accesses the remote terminal unit to the subscriber line.

[0034] The method further comprises in step B:

[0035] when disconnecting the remote terminal unit from the subscriber line, said remote terminal subscriber access control module returns a response message to the broadband line testing control module;

[0036] the method further comprises before step C:

[0037] the broadband line testing control module receives the returned response message from the remote terminal subscriber access control module, and executes step C after delaying a defined time period.

[0038] Said sending a signal to a remote terminal subscriber access control module in step A is implemented through terminal managing channels of DSLAM.

[0039] It can be seen from the above-mentioned technical schemes, in the present invention, a remote terminal subscriber access control module is added at the subscriber line between an RTU and a broadband line testing control module, in this way, when the broadband testing control module starts to implement subscriber line testing, remote controlling RTU to automatically disconnect from the subscriber line can be realized through remotely controlling the switch status of the remote terminal subscriber access control module, and automatic connection between the RTU and the subscriber line can be restored after completion of subscriber line testing. Therefore, the problem of poor testing precision or unable to perform corresponding test due to the existence of RTU in subscriber line is effectively avoided. Meanwhile, since remote control of RTU's accessing to or disconnected from subscriber line is implemented in the present invention, the subscriber line testing performed by the broadband testing control module needs no manual operation, which is greatly convenient for periodically testing subscriber lines by DALAM end and recording subscriber line health file, henceforth in favor of real-time inspection of subscriber line quality and fast positioning of subscriber line breakdown.

Brief Description of the Drawings

[0040] Figure 1 is a schematic diagram illustrating system structure for testing subscriber lines according to the prior art.

[0041] Figure 2 is a schematic diagram illustrating brief system structure for testing subscriber lines according to the present invention.

[0042] Figure 3 is a schematic diagram illustrating detailed system structure for testing subscriber lines according to the present invention.

[0043] Figure 4 is a flowchart illustrating the method for testing subscriber lines according to the present invention.

Detailed Description of the Invention

[0044] The present invention will be described in detail hereinafter with reference to the accompanying drawings.

[0045] According to the embodiments of the present invention, RTU is connected with the subscriber line via a relay. A broadband line testing control module in DSLAM remotely controls off/on status of this relay, thereby controls RTU to connect to or disconnect from the subscriber line, making it convenient for corresponding subscriber line testing.

[0046] As shown in Figure 2, a relay is added between the RTU and the subscriber line in an exemplary embodiment of the present invention. When the subscriber line needs testing, the broadband line testing control module in DSLAM instructs the relay to switch its status, making RTU disconnect from the subscriber line. After overrunning a time-out time set by the DSLAM, the relay automatically switches its status again and restores the connection with subscriber line. So the RTU can be reconnected to the subscriber line after the testing and be operated normally.

[0047] The relay according to a preferred embodiment of the present invention can be set either on the subscriber line between the splitter at user side and the RTU, or on that between the splitter at user side and the DSLAM. The relay shown in Figure 2 is set on the subscriber line between the splitter at user side and the RTU. If the relay is added on the subscriber line between the splitter at user side and the RTU, when the connection between this subscriber line and RTU is broken by the relay, the subscriber line is still connected to devices such as a splitter and a telephone that will affect the testing precision of this subscriber line. In contrast, if the relay is added on the subscriber line between the splitter at user side and the DSLAM, when the connection between this subscriber line and the RTU is broken by the relay, this subscriber line will not be connected to any device, hence high testing precision can be obtained.

[0048] In the following embodiment according to the present invention, the relay is set on the subscriber line between the splitter at user side and the RTU.

[0049] As shown in Figure 3, a system for testing subscriber lines according to an exemplary embodiment of the present invention includes a broadband line testing control module and a remote terminal subscriber access control module which is placed between the broadband line testing control module and the RTU.

[0050] The broadband line testing control module is used to notify the remote terminal subscriber access control module to disconnect the RTU from the subscriber line when the subscriber line needs testing and start subscriber line testing. The control signals sent to the remote terminal subscriber access control module from the broadband line testing control module can either be inputted manually, or be automatically generated according to relevant condition. For example, the control signals for disconnecting the RTU from the subscriber line are periodically generated in order to test the subscriber lines periodically.

[0051] The broadband line testing control module further includes a broadband line testing module and a remote terminal subscriber control module.

[0052] The broadband line testing module is adapted to send a signal to the remote terminal subscriber control module so as to notify the remote terminal subscriber control module to disconnect the RTU from the subscriber line when the subscriber line needs testing, and to implement various performance test for the subscriber lines and hence obtains corresponding test results after the RTU has been disconnected from the subscriber line.

[0053] The remote terminal subscriber control module is adapted to send control signals to the remote terminal subscriber access control module through subscriber lines after receiving the signal for notifying subscriber line testing from the broadband line testing module. The control signals includes the control signals for controlling the RTU to disconnect from the subscriber lines, as well as the time period required for broadband testing which is used to determine the time point to reconnect itself to the subscriber lines by the RTU.

[0054] In the exemplary embodiment of the present invention, a remote terminal subscriber access control module is provided for receiving control signals from the broadband line testing control module, and controlling the RTU to connect to or disconnect from the subscriber lines based on the received signals. The remote terminal subscriber access control module further includes a switch control module and a remote terminal subscriber control switch.

[0055] The switch control module is used to receive signals from the broadband line testing control module, generate corresponding control signals and send the

control signals to the remote terminal subscriber control switch, so as to control the off/on status of the remote terminal subscriber control switch, thereby controlling the RTU to connect to or disconnect from the subscriber lines.

[0056] The remote terminal subscriber control switch is used to switch the on off state based on the control signals from the switch control module. If the on state is required, the RTU disconnects from the subscriber lines. In contrast, if the off state is required, the RTU connects to the subscriber lines.

[0057] The switch control module may include a timer circuit, which is triggered based on the received signal from the remote terminal subscriber control module. The switch control module determines corresponding time-out time according to the information carried by the signal, and sends a control signal for asking the remote terminal subscriber control module to change its status to the remote terminal subscriber control module when the timer in the timer circuit overruns. As to the broadband line testing module of the system provided in the present invention, the time period required for testing is carried in the signal sent to the remote terminal subscriber control module only when it is required to perform subscriber line testing. In this way, at the user end, when the timer overruns, the switch control module can automatically control the remote terminal subscriber control switch to return to normal status, namely reconnecting the RTU to the subscriber lines.

[0058] The remote terminal subscriber access control module can be a relay or any other device with similar function to that of a relay.

[0059] In the system for testing subscriber lines in network communication, the broadband line testing control module is set in the DSLAM; the remote terminal subscriber access control module is located between the subscriber line at user end and the RTU, or set inside the RTU.

[0060] As shown in Figure 4, a method for testing subscriber lines in network communication based on the above system includes the following steps.

[0061] In step 41, when it is determined that the subscriber line needs testing, the broadband line testing control module sends a handshake message to the RTU, and receives the returned response message to judge whether this testing is supported by the RTU.

[0062] Before testing, G.994.1 standard is executed to perform handshake operation between the broadband line testing control module and the RTU. The broadband line testing control module and the RTU exchange the message indicating whether testing switch is supported through G994.1 Protocol.

[0063] In step 42, the broadband line testing control module determines whether this testing is supported by the RTU according to the returned response message from the RTU, if yes, step 43 will be executed for the RTU supporting this testing, otherwise step 46 will be executed.

[0064] If the RTU supports testing switch, the seventh bit of "Identification field-Npar (1)" of Capability List Request (CRL) in G.994.1 is set at 1; meanwhile a command for indicating that RTU supports testing switch is defined in "Non-standard field" in G.994.1 frame. While at DSLAM end, if the DSLAM is to perform testing switch handshake, the seventh bit of "Identification field-Npar (1)" of Capability List (CL) is set at 1, meanwhile a command for indicating that DSLAM requests the RTU to perform testing switch and simultaneously notifies the RTU with the elapse time between switch off and switch back to the normal mode is defined in "Non-standard field" in G.994.1 frame.

[0065] After G.994.1 protocol is executed, if the seventh bit of the NPar(1) which is received by the broadband line testing control module in the DSLAM from the RTU is 1, the broadband line testing control module reads the command in "Non-standard field", if the command indicates that RTU supports this testing switch, step 43 will be executed, otherwise step 46 will be executed.

[0066] If the signal sent by the broadband line testing control module in DALAM from the RUT is not a CLR frame, it is necessary for the broadband line testing control module to send the RTU a CLR frame request message for requesting the RTU to send a CLR frame. After receiving the CLR frame, the broadband line testing control module implements the above processing.

[0067] In step 43, the broadband line testing control module sends a control signal bearing the time period for testing to the remote terminal subscriber access control module.

[0068] The above-mentioned control signal can be sent to the remote terminal subscriber access control module by means of a message based on G.994.1 protocol.

[0069] The above-mentioned control signal is used to ask the RTU to perform testing switch, namely to disconnect from the subscriber line, and to notify the RTU with a switch restoring time, namely the time point to reconnect the RTU back to the subscriber line. The above-mentioned control signal is a CL command sent from the DSLAM, including a switch starting command and a switch time in "Non-standard field" of the frame.

[0070] In step 44, the remote terminal subscriber access control module disconnects the RTU from the subscriber line after receiving the control signal.

[0071] Meanwhile, after receiving the control signal, the remote terminal subscriber access control module starts a timer and sets a time-out time according to the testing time period carried by the received control signal. When the timer overruns, the remote terminal subscriber access control module reconnects the RTU to the subscriber line,

[0072] In addition, before the remote terminal subscriber access control module disconnects the RTU from the subscriber line, step 44 may further includes the step of returning a response message to the broadband line testing control module to notify it that the RTU has been disconnected from the subscriber line.

[0073] After receiving the CL command of DSLAM, the remote terminal subscriber access control module sends an acknowledgement message (ACK (1)) to the DALAM and starts testing switch simultaneously. After the testing switch of RTU, the remote terminal subscriber access control module starts timing according to the information carried in the CL command, if the time period set in the CL command is over, the RTU is switched back to normal access status and reconnected to the subscriber line.

[0074] In step 45, after the RTU is disconnected from the subscriber line, the broadband line testing module in the broadband line testing control module starts to test the subscriber line.

[0075] Corresponding to step 44, after receiving the returned response message from the remote terminal subscriber access control module and after a delay, the

broadband line testing module in the broadband line testing control module starts to test the subscriber line, in order to make sure that the RTU has been safely disconnected from the subscriber line, accordingly guaranteeing the precision of corresponding testing results.

[0076] In other words, after receiving ACK(1) sent by the RTU and after a delay, the broadband line testing module in the broadband line testing control module starts testing for broadband testing items.

[0077] In step 46, this testing processing is ended.

[0078] If the broadband line testing control module in DSLAM determines that testing switch function is not supported by the RTU, it displays the information that testing switch function is not supported by the RTU when this testing processing is ended.

[0079] Under the active state of RTU, the broadband line testing control module can send "testing switch and testing switch time" command to the RTU by way of the terminal managing channels of each port of each XDSL service sub-board in the DSLAM.

[0080] In the present invention, the above-mentioned RTU can be RTU of ADSL, VDSL or SHDSL.

[0081] While the invention has been shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.